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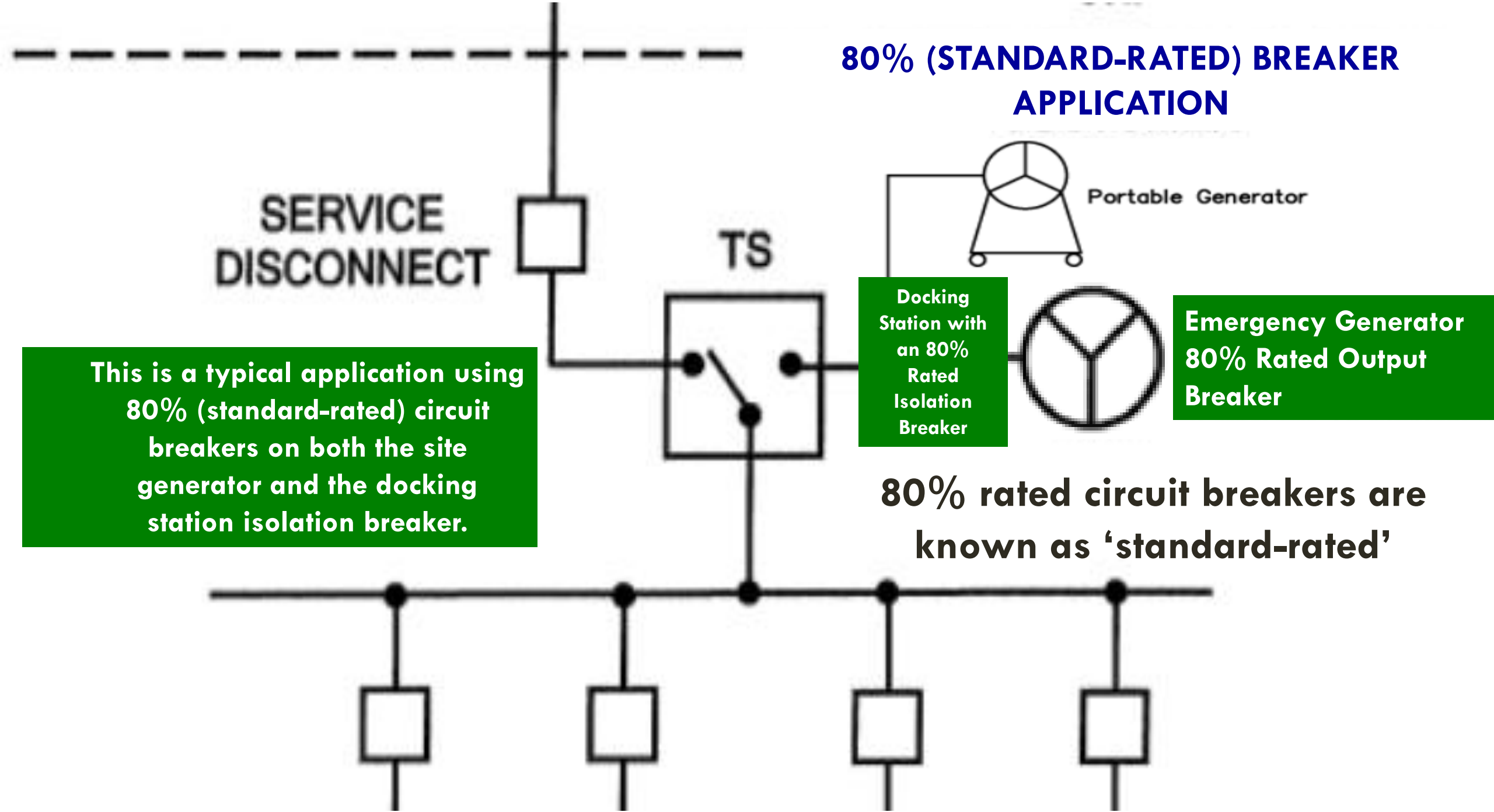
How can I determine if I need an 80% (standard-rated) or 100% rated breakers for a generator docking station?

Why would I need a 100% rated breaker in the docking station?

Why do we have 80% (standard-rated) & 100% rated breakers?

Docking stations typically use a manual transfer switch, a disconnect or a circuit breaker to electrically isolate the site generator. In this capacity, the circuit breaker is called an isolator or **isolation breaker**, since it is being used as an On/Off switch to isolate the site generator from the load as opposed to being a circuit limiting device. It is still an overcurrent protection device in the 'on' position, but that's not it's purpose or primary function. Since all power from the site generator passes through the isolation breaker, the breaker in the docking station needs to have the same capacity as the site generator output breaker or the isolation breaker will limit the generators output.

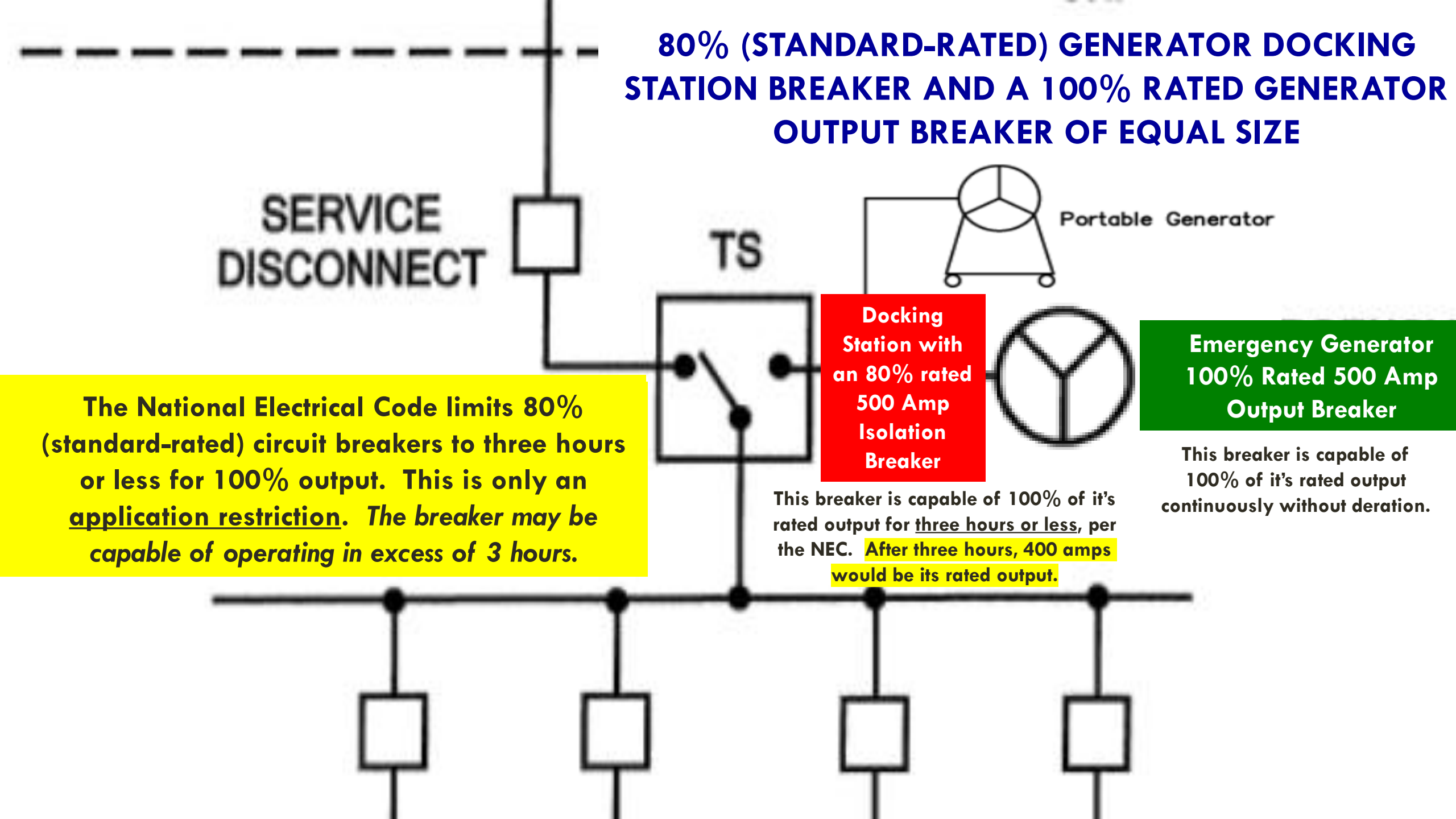
80% (STANDARD-RATED) BREAKER APPLICATION



This is a typical application using 80% (standard-rated) circuit breakers on both the site generator and the docking station isolation breaker.

80% rated circuit breakers are known as ‘standard-rated’

80% (STANDARD-RATED) GENERATOR DOCKING STATION BREAKER AND A 100% RATED GENERATOR OUTPUT BREAKER OF EQUAL SIZE



Docking Station with an 80% rated 500 Amp Isolation Breaker

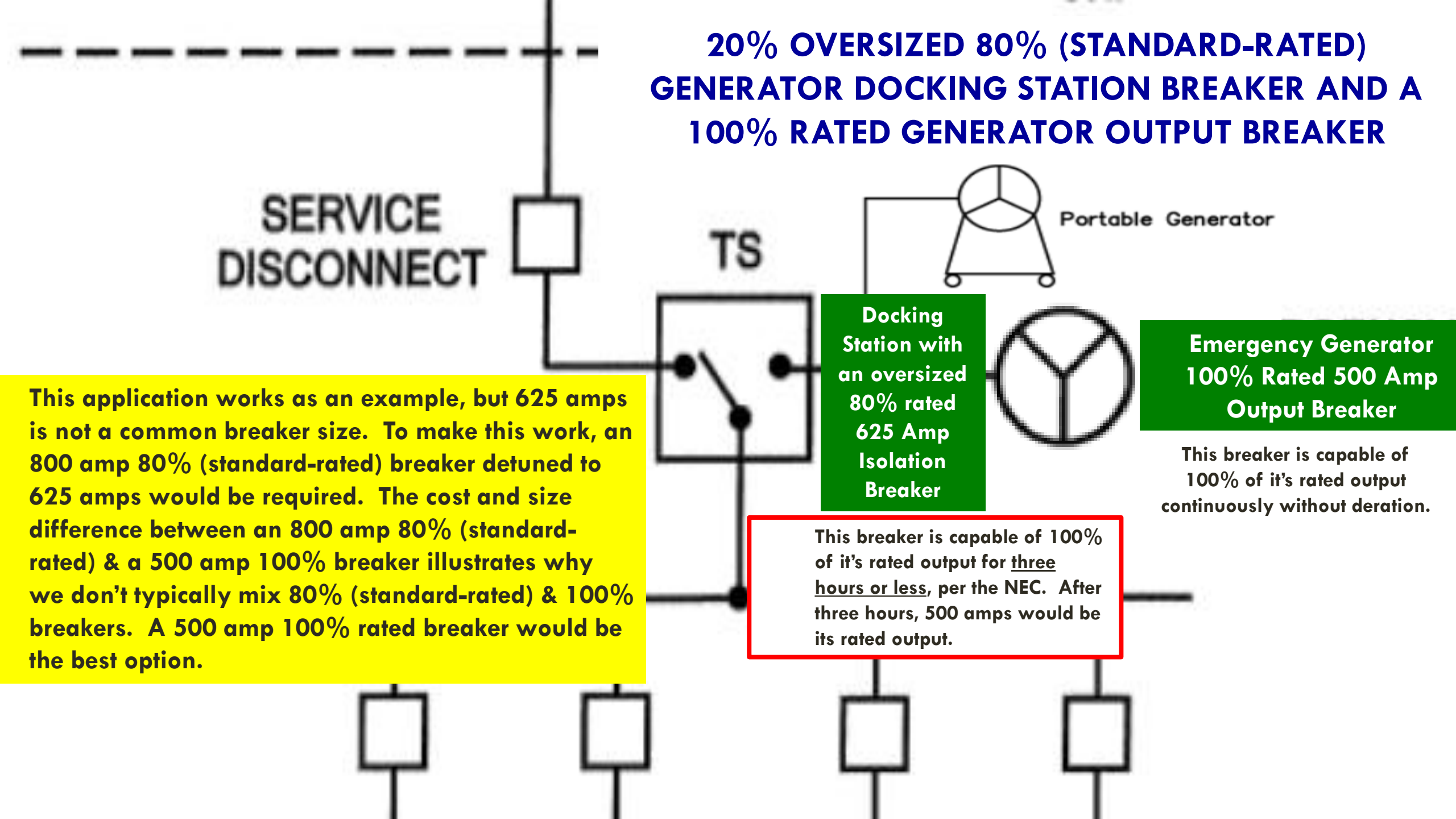
This breaker is capable of 100% of it's rated output for three hours or less, per the NEC. After three hours, 400 amps would be its rated output.

Emergency Generator 100% Rated 500 Amp Output Breaker

This breaker is capable of 100% of it's rated output continuously without deration.

The National Electrical Code limits 80% (standard-rated) circuit breakers to three hours or less for 100% output. This is only an application restriction. *The breaker may be capable of operating in excess of 3 hours.*

20% OVERSIZED 80% (STANDARD-RATED) GENERATOR DOCKING STATION BREAKER AND A 100% RATED GENERATOR OUTPUT BREAKER



This application works as an example, but 625 amps is not a common breaker size. To make this work, an 800 amp 80% (standard-rated) breaker detuned to 625 amps would be required. The cost and size difference between an 800 amp 80% (standard-rated) & a 500 amp 100% breaker illustrates why we don't typically mix 80% (standard-rated) & 100% breakers. A 500 amp 100% rated breaker would be the best option.

How can I determine if I need an 80% (standard-rated) or 100% rated breaker for a generator docking station quote or bid?

Consult the one-line drawing & job specifications. The design engineer should have performed load calculations to determined what is required for feeders, conductors and the circuit protection. If there are no references or markings indicating a 100% rated breaker on the docking station isolation breaker, the assumption is that an 80% or "**standard-rated breaker"** is used.

The isolation breaker required for the docking station should match the generator output breaker amperage rating and loading requirements time-wise The site generator specifications are a good place to find the generator output breaker rating.

(this was found by searching the PDF job specification for "breaker"…reference to 80% rated)

2.6 GENERATOR OVERCURRENT AND FAULT PROTECTION

A. Generator Circuit Breaker: LSI adjustable electronic-trip type; 80 percent rated; complying with NEMA AB 1 and UL 489.

1. Tripping Characteristic: Designed specifically for generator protection.

2. Trip Rating: Refer to the one-line diagram on the contract drawings.

3. Mounting: On generator set in an enclosure.

If you can't find the answer in the one-line diagram, job specification or the generator specification, ask the engineer of record for confirmation or note an 80% rating for the docking station isolation breaker on the quote or bid.

Why would I need a 100% rated breaker in the docking station?

The site generator may be rated for a continuous 100% load and requires a circuit breaker that can supply the maximum generator current output for over three hours and or the temperature rating for the generator output breaker's environment requires a 100% rated breaker to allow for the temperature rise on the breaker terminals.

80% (standard-rated) breakers are limited by NEC code to supply 100% output for three hours or less. 100% breakers are continuous at full rated output.

80% (standard-rate) Breaker

UL 489 Paragraph 7.1.4.2.2 says the temperature rise on a **wiring terminal shall not exceed 90°F** with a maximum temperature of 194°F with a 104°F ambient air temperature.

100% Rated Breaker

UL489 Paragraph 7.1.4.3.3 says the temperature rise on the **termination shall not exceed 108°F** with a maximum temperature of 212°F with 104°F ambient air temperature.

Why do we have 80% (standard-rated) & 100% rated breakers?

Electrical system design and the load calculations thereof determine the requirements for the feeders, conductors and circuit protection required for a given job or project. In those load calculations, there are two types of loads to account for, **continuous and noncontinuous**. These loads, the cost of the breakers and the associated wiring are the determining factors in the breaker size and ratings specified. The engineer of record is the one that provides this information in the job specifications and the single-line diagram.

NEC Chapter 1 Article 100 Definitions
A continuous load is one where the maximum current is expected to continue for 3 hours or more.
80% (standard-rated) breakers for continuous loads are sized at **125% of the load, per NEC 210.20(A)**. Think oversized, by 20%. 100% rated breakers are sized to meet the load. No need to oversize with a 100% rated breaker. In a hospital for example, lighting would be a continuous load.

Based on the definition for a continuous load, a noncontinuous load is one where the maximum current is less than 3 hours in duration. 80% (standard-rated) breakers for noncontinuous loads are sized at 100% of the load. No oversizing required. This means they require a 20% smaller or less expensive breaker than a continuous load. Back to the hospital, a good example of a noncontinuous load would be imaging equipment (X-ray machine, MRI or a CT scanner). They demand a lot of electricity, but they represent a short duration load well under 3 hours in duration.

Depending on the mix of continuous and noncontinuous loads, the design engineer calculates the size of the feeders and conductors for the equipment loads involved. After that, they determine the overcurrent protection device for that wiring using a calculation like the ones below.

80% (STANDARD BREAKER) RATED SYSTEM

LOAD CURRENT = (CONTINUOUS LOAD AMPS X 1.25) + NONCONTINUOUS LOAD AMPS

Notice the 1.25 multiplier for continuous loads with an 80% (standard-rate) breaker. That's a 20% oversize.

100% (STANDARD BREAKER) RATED SYSTEM

LOAD CURRENT = CONTINUOUS LOAD AMPS + NONCONTINUOUS LOAD AMPS

On applications with only noncontinuous loads (max current for less than 3 hours duration), both calculations produce the same amperage circuit breaker. Factor in the cost of each breaker, the 80% (standard-rated) is the most cost-effective choice.

If the application has only continuous loads, there is a choice to make….oversize the 80% (standard-rated) breaker 20% or go with the 100% rated breaker. The breaker cost, size & wiring cost will be the deciding factors.

Example

2,000 Amp continuous loads = **2,500 amp 80% (standard-rated) breaker** or **2,000 amp 100% rated breaker.**

If the application has a mix of loads, it gets more complicated, but it will go back to breaker cost, size & wiring cost.

Continuous and noncontinuous loads and their respective circuit protection requirements are why we have 80% (standard-rated) and 100% rated circuit breakers.

We provide this information to serve our customers and their business interests. We endeavor to provide the most accurate information possible. With code or compliance related information, it is subject to change or revision. Please use this document as an educational reference or learning tool to acquaint yourself with the 80% (standard-rated) and 100% circuit breakers we use in power generation.

If you discover an error or a critical omission, please contact us and we will update our data accordingly.

Davidson Sales Company